5.0 PROCESS DESCRIPTION

The Hanford 300-Area Water Treatment Facility uses gaseous chlorine to disinfect the drinking water supply at the Hanford Site 300-Area in accordance with the Washington State Administrative Codes (WAC) 246-290. Two independent chlorination systems are installed at the Water Treatment Facility. These systems can be operated separately or in parallel. Because they are typically operated separately, this study addresses only one system. Figures 1 through 4 are simplified diagrams of the chlorination process. Figures 5 through 8 are photographs of the chlorine cylinder storage area and the chlorination room. The chlorination system was partially installed and not yet operating at the time of the hazard and operability (HAZOP) study.

Within the chlorine cylinder storage area of the Water Treatment Facility, liquid chlorine is stored in two l-ton cylinders (see Figures 6, 7, and 8). One cylinder is normally in service, and the other is in standby mode for use when the contents of the in-service cylinder are depleted.

Chlorine leak detection and warning are provided by two sets of alarms. The alarms sound locally at the Water Treatment Facility and remotely at a separate facility that is staffed 24 hours a day. One alarm indicates a chlorine concentration of 1.0 part per million (ppm) and is used to detect a slow buildup of chlorine. A second alarm, set at 5.0 ppm, is used to detect larger chlorine releases. The chlorine cylinder storage area is also equipped with a manually activated exhaust vent system to evacuate chlorine before personnel entry.

Chlorine cylinders are placed on trunnions and dollies to move them in and out of the storage area (see Figure 6). The dollies operate on fixed tracks with “stops” to prevent them from traveling too far. Wheel chocks prevent movement of the dollies while the chlorine cylinders are in use.

Two gaseous chlorinators are installed in a separate room adjacent to the chlorine cylinder storage area. The chlorinators meter and inject gaseous chlorine into the raw water supply as it enters the Water Treatment Facility sedimentation basins. The chlorination room is equipped with an exhaust vent fan and chlorine leak detection system. The leak detector is equipped with alarm capabilities that alarm both locally and remotely at a separate facility that is staffed 24 hours a day.

Chlorine gas is supplied from the in-service chlorine cylinder at approximately 75 psig to a vacuum regulator mounted directly to the cylinder gas supply valve. An automated switch-over valve is installed between the containers to allow both containers to be connected to the in-use chlorinator at the same time. As one container approaches depletion, a sensor detects the high-vacuum condition causing the valve to switch to the standby container. The vacuum regulator reduces the pressure from the cylinder by using a water ejector to create a vacuum within the system. The regulator is designed to fail “closed” any time a loss of vacuum is experienced within any component of the system. The regulator is also designed to relieve the pressure from the system.

Gaseous chlorine is drawn through a flow rate indicator/controller, an automatic control valve, and a differential pressure regulator, to a water ejector. The chlorine rate indicator is set manually to maintain a feed rate of 20 to 60 pounds per day. Feed rate depends on ambient weather conditions and the quantity of water processed. Chlorine gas is mixed with water from the clear-well as the gas passes into the water stream at the water ejector. The chlorinated water is then discharged into the raw water supply at the influent chamber, where initial treatment of the water supply begins. The water undergoes sedimentation and filtering (rapid sand filters) before entering the 70,000-gallon clear-well reservoir.

The water system is monitored during each shift for residual chlorine. Monitoring occurs at the clear-well and at various facilities throughout the Hanford 300-Area to assure that the proper amount of chlorine is present to effectively disinfect the water supply. Depending on the results of the monitoring, the chlorine feed rate is manually adjusted to maintain sufficient chlorine for disinfection.

Chlorine cylinders are delivered to the chlorine cylinder storage building on flat bed trucks as needed. The cylinders are loaded and unloaded from the truck using a mobile crane. Hoisting and rigging crews are trained to perform the loading and unloading activities.

In case of system outages, a water line from the City of Richland can temporarily supply water to the Hanford 300-Area.

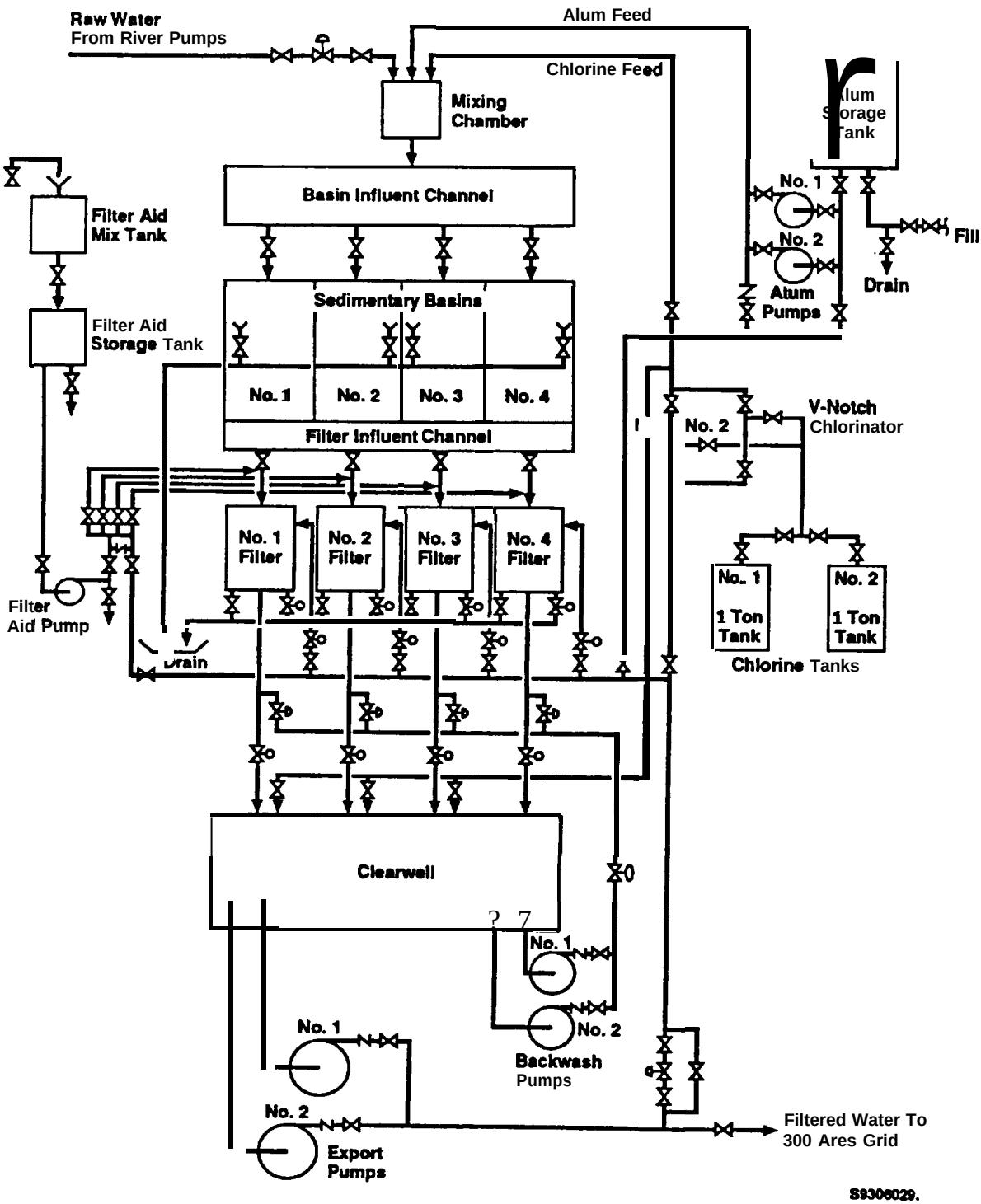

Figure 1. Process Flow Diagram of the Hanford 300-Area Water Treatment Facility

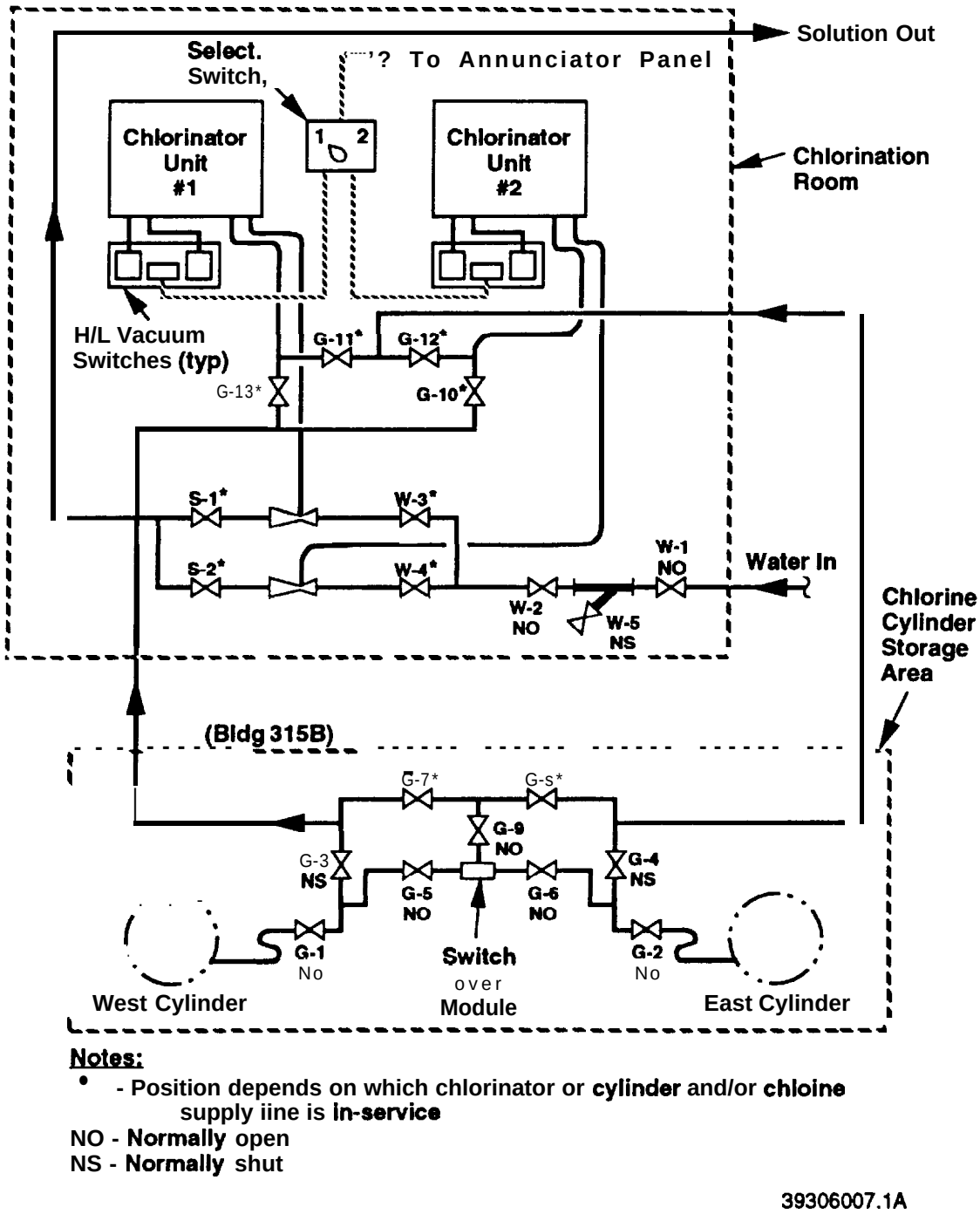

Figure 2. Chlorination Process Flow Diagram, Water Treatment Facility

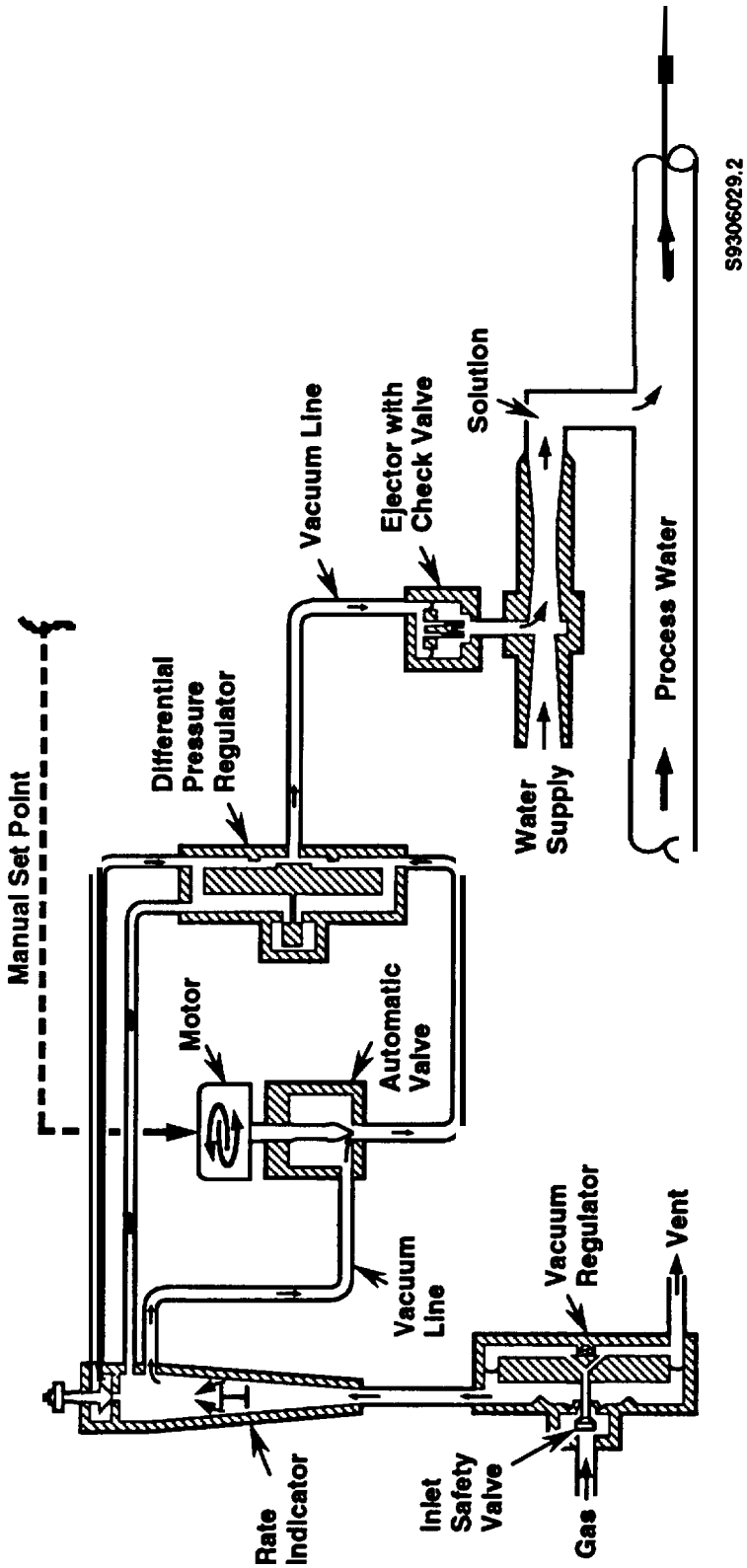

Figure 3. Automatic Gas Feed System, Chlorination Process

PARTS LIST

VACUUM REGULATOR
CHLORINE
200 PPD (4kg/h) MAXIMUM

CAPITAL CONTROLS
COMPANY, INC
PO Box 211

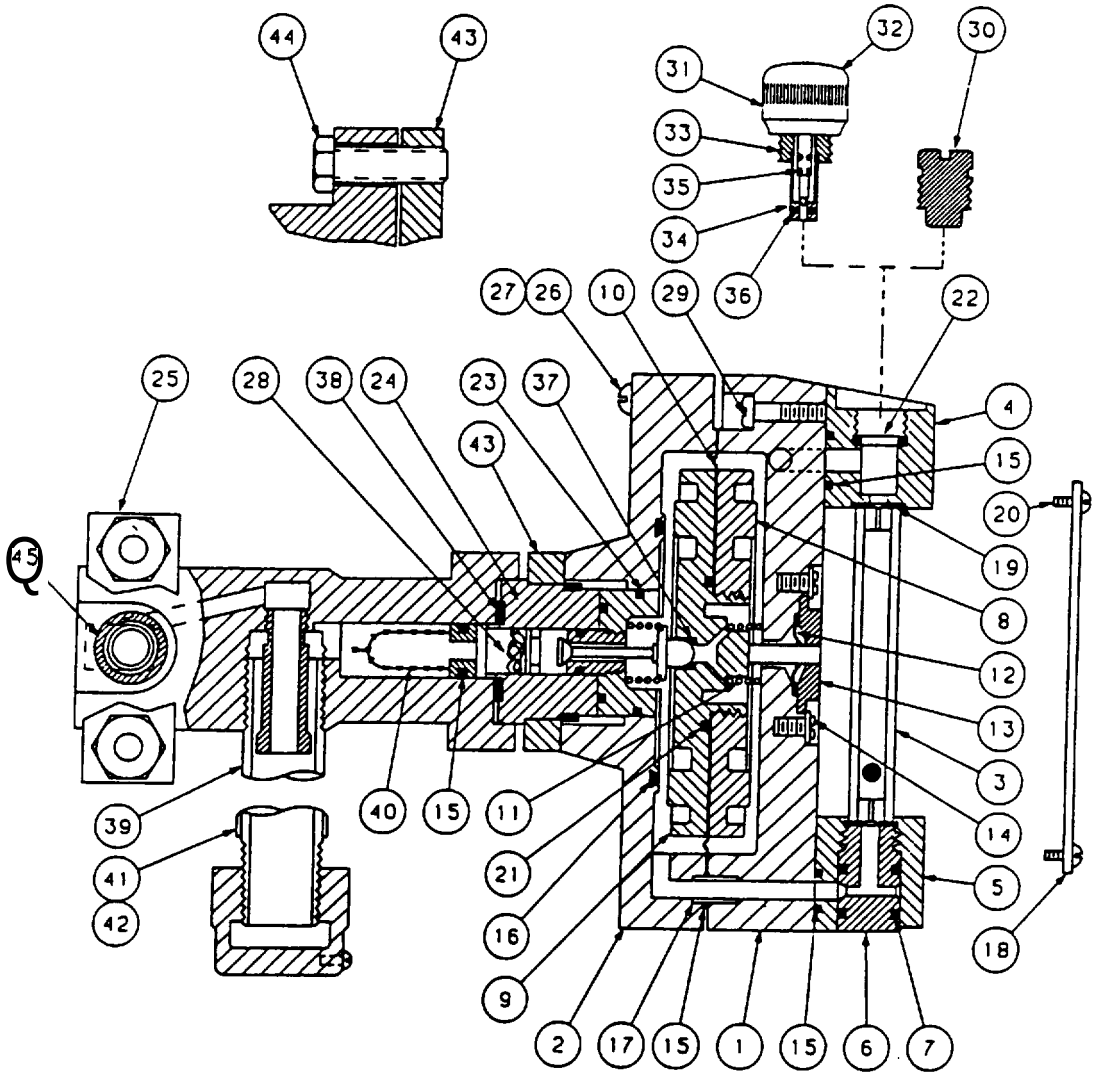

Figure 4. Vacuum Regulator, Automatic Gas Feed System

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	FRONT BODY	SEE CHART IV
2	1	BACK BOOY	U-160
* 3	1	FLOWMETER ASSEMBLY	sEE CHART I
4	1	FLOWMETER TOP FITTING	M-117
6	1	FLOWMETER BOTTOM FITTING	M-1 16
+ 6	1	METER INLET PLUG	U-140
+ 7	2	O-RING	OV-11-112
+ 8	1	DIAPHRAGM FRoNT PLATE	U-269
+ 9	1	DIAPHRAGM BACK PLATE	A-363
+ 10	1 SET	DIAPHRAGM (2 PER SETI	0-106
11	1	RELIEF SPRING	s-loo
+ 12	1	SEALING DIAPHRAGM	D- 102
13	1	SEAL COVER	U-137-1
14	2	SCREW, 10-24 X 3/16 LG	N-128
+ 16	4	D-RING	OV-11-012
+ 16	1	O-RING	OV-1 1-332
+ 17	1	FLOW TUBE	U-162
18	1	FRONT PLATE	R-2204
" 19	2	METER GASKET	SEE CHART I
20	2	SCREW, 6-32 X 1/4 LG	N-302
+ 21	1	O-RING	OV-1 1428
+ 22	1	O-RING	OV-11-110
+ 23	1	O-RING (SEE NOTE 6)	OV-11-212
+ 24	1	INLET CAPSULE ASSEMBLY	BM-4869
26	1	YOKE ASSEMBLY ISEE NOTE 4)	sEE CHART III

ITEM NO.	QTY.	DESCRIPTION	PART NO.
26	2	SCREW, 1 /4-20 X 2-3/4 LG	N-125
27	6	SCREW, 1 /4-20 X 1 -3/4 LG	N-124
+ 28	1	REPLACEMENT FILTER ISEE NOTE 6)	I3M-1023
29	4	SCREW, 10-24 X 1 LG	N-128
30	1	BONNET PLUG	M-175
31	1	RATE VALVE ASSEMBLY	SEE NOTE 3
32	1	VALVE STEM ASSEMBLY	SEE CHART I
33	1	VALVE BONNET	V- 124
34	1	VALVE SLEEVE	SEE CHART I
+ 36	2	O-RING	OV-11-006
+ 36	1	O-RING	OV-11-010
+ 37	1	O-RING	Ov-11 -009
+ 38	1	LEAD GAsKET (SEE NOTE 6)	G-ill
3s	1	INLET ASSEMBLY	SEE CHART III
+ 40	1	INLET FILTER ASSEMBLY	BM-1278
" 41	1	HEATER	SEE CHART II
+ 42	2	MOUNTING CUP	T-458
43	1	BODY PLATE	T-1 163-1
44	2	BOLT. HEX 3/8-16 X 1 LG	N-139
46	1	LEAD GASKET (SEE NOTE 5)	SEE CHART III
NS	1	3/8 TUBING CONNECTOR (VENT)	F-loo
+ N/S	1	1/2 TUBING CONNECTOR (VACUUM)	F-106

N/s - NOT SHOWN

CHART I

ITEM NO.	CAPACITY IN PPD (KG/H)			
	25 (0.5)	50 (1.0)	100 (2.0)	200 (4.0)
3	A-108-6	A-108-6	A-108-8	A-108-9
19	G-100-6	G-100-7	G-100-7	G-100-4
31	BM-11 8-3	BM-1 18-3	BM-11 B-3	BM-11S-4
32	A-859-3	A-859-3	A-859-3	A-859-4
34	V-1 26-3	V- 126-3	v-126-3	V-126-4

CHART II

ITEM NO.	VOLTAGE	
	120 VAC 25 WATT	240 VAC 25 WATT
41	R-ill	R-280

CHART III

ITEM NO.	CONNECTIONS		
	U.S. LEFT HAND	U.S. RIGHT HAND	JAPAN
25	A-128	A-128	A-825
39	A-738-L	A-738-R	BM-1 160
46	G-ill	0-111	G-120

CHART IV

ITEM NO.	WITH LOSS OF GAS SWITCH	WITHOUT LOB3 OF GAS SWITCH
1	SEE P/L B3.7 133	A-107

NOTES:

1. (+) AND (*) INDICATES RECOMMEND ED AS MINIMUM SPARE PARTS. QUANTITY RECOMMENDATIONS ARE FOR AVERAGE USE AND CONDITIONS. ADDITIONAL PARTS AND QUANTITIES SHOULD BE CONSIDERED WHERE THE EQUIPMENT Is USED To ITS FULLEST CAPABILITY OR WERE LOCATED IN AN AREA REMOTE FROM CONVENIENT SERVICE.
   (A) To ORDER RECOMMENDED SPARE PARTS INDICATED BY (+) SPECIFY BM-3259.
   (B) TO ORDER RECOMMENDED SPARE PARTS INDICATED BY 1") SPECIFY INDIVIDUAL PARTS.
2. WHEN ORDERING PARTS, SPECIFY GAS FEEDER CAPACITY, MODEL NUMBER, ANO SERIAL NUMBER.
3. ITEM NO. 31 INCLUDES ITEM NOS. 22, 32, 33, 34, 36, AND 36. TO ORDER COMPLETE RATE vALVE ASSEMBLY BEE CHART L
4. ITEM 26 YOKE ASSEMBLY IS INCLUDED IN ITEM 39 INLET ASSEMBLY.
6. TO ORDER TWELVE (121 GASKETS SPECIFY THE FOLLOWING:
   FOR G-1 11 SPECIFY BM-918
   FOR G-120 SPECIFY BM-919.
6. ITEM 23 O-RING AND ITEM 2B FILTER INCLUDED IN ITEM 24 INLET ASSEMBLY.

Figure 4. Vacuum Regulator, Automatic Gas Feed System (continued)

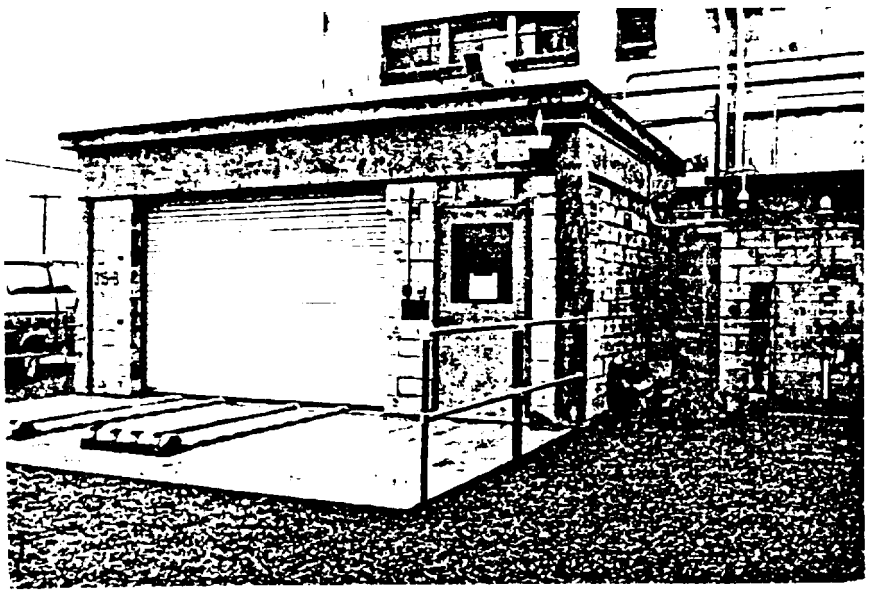

Figure 5. Building Housing Chlorine Cylinders and Chlorination Process Equipment

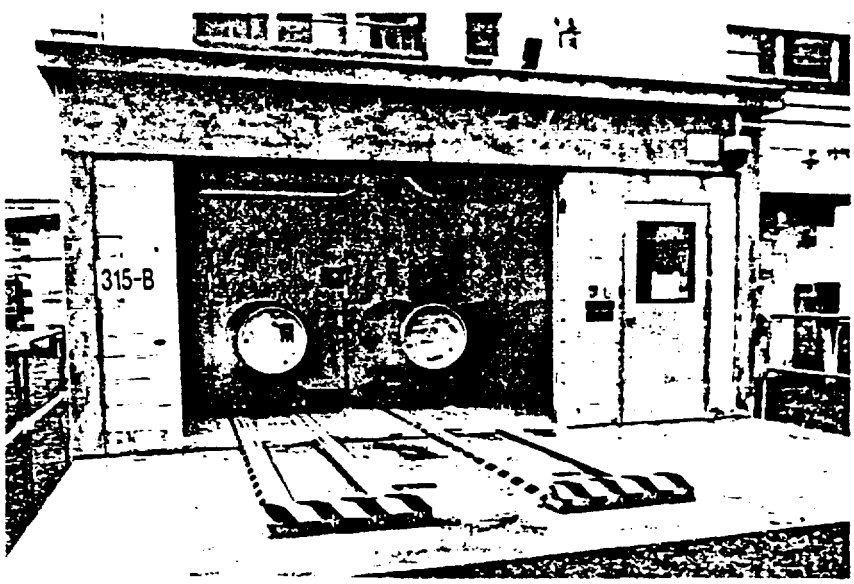

Figure 6. Chlorine Cylinder Storage and Change-out Area, Overhead Door Open

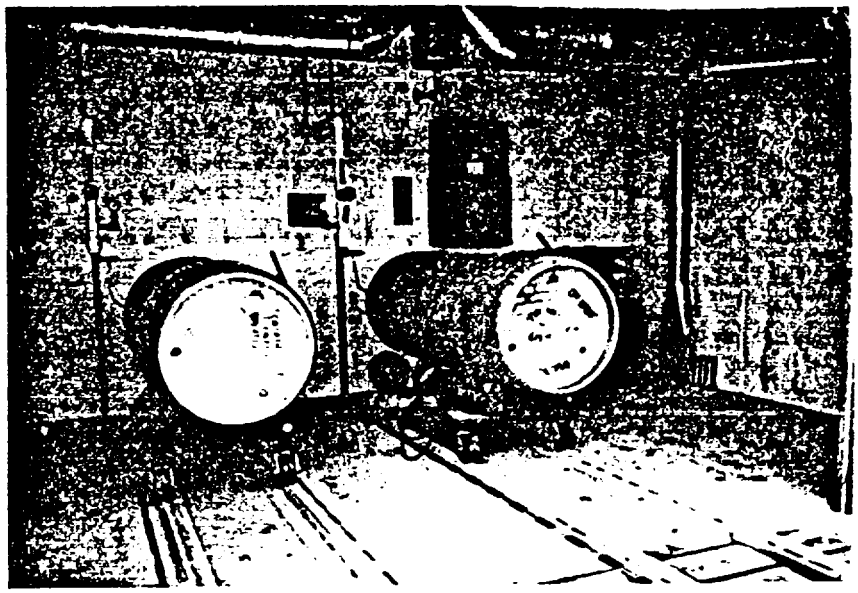

Figure 7. Chlorine Cylinders in the Chlorine Cylinder Storage Area, Front View

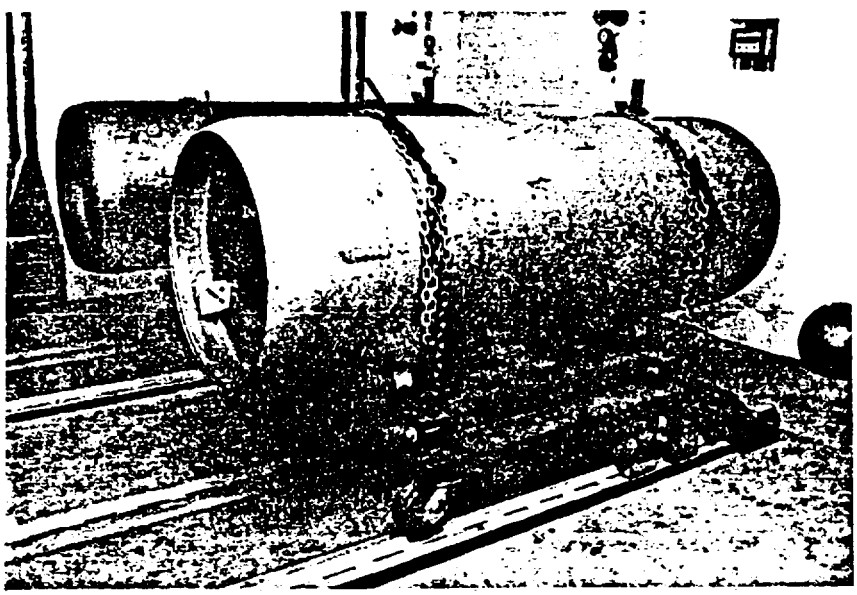

Figure 8. Chlorine Cylinders in the Chlorine Cylinder Storage Area, Side View